## Bonneville Power Administration
## Fish and Wildlife Program FY99 Proposal

### Section 1. General administrative information

# Mitigation For The Construction And Operation Of Libby Dam

**Bonneville project number, if an ongoing project** 8346700

**Business name of agency, institution or organization requesting funding**
Montana Fish, Wildlife & Parks

**Business acronym (if appropriate)** MFWP

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**Subcontractors.**

| Organization | Mailing Address | City, ST Zip | Contact Name |
|---|---|---|---|
| Payne and Associates | 850 G. St. Suite J. | Arcata, CA 95521 | Thomas R. Payne |
| University of Idaho | Aquiculture Research | Moscow, ID 83844 | Dr. Matt Powell |
| Wildlands Hydrology | 1481 Stevens Lk. Rd. | Pagosa Springs, CO 81147 | Dave Rosgen |
| WestWater Consultants | 1112 Catherine Ln. | Corvallis, MT 59828 | Gary Decker |

**NPPC Program Measure Number(s) which this project addresses.**
Program Measures10.1B, 10.1C.1, 10.3B, 10.3B.2, 10.3B.3, 10.3B.5, 10.3B.6, 10.3B.7, 10.3B.10 and 10.3B.11.

**NMFS Biological Opinion Number(s) which this project addresses.**

Kootenai River White Sturgeon Biological Opinion (59 FR 45989)

NMFS Hydrosystem Operations for salmon recovery (56 FR 58619; 57 FR 14653)
Bull Trout Proposed Listing (62 FR 32268)
Westslope cutthroat trout and Interior redband trout recovery actions

**Other planning document references.**

White Sturgeon Recovery Plan (Draft 1997)

Fisheries Mitigation and Implementation Plan for Losses Attributable to the Construction and Operation of Libby Dam. 1997. (Draft plan by MFWP, CSKT and KTOI is based on public comment from four public meetings in Libby and Eureka, Montana and agency review. The draft plan has been released for further public review prior to submission to NPPC for approval).

Kootenai Watershed Programmatic Habitat and Physical Parameter Review (Bibliography)
Open File Report – MFWP-Libby, MT

**Subbasin.**

Kootenai Subbasin, Upper Columbia

**Short description.**

Execute watershed / habitat enhancement projects mitigating hydropower impacted native fish populations. Implement operational plan for Kootenai River and Libby Reservoir. Recover endangered Kootenai white sturgeon. Develop burbot recovery program.

## Section 2. Key words

| Mark | Programmatic Categories | Mark | Activities | Mark | Project Types |
|---|---|---|---|---|---|
| | Anadromous fish | | Construction | + | Watershed |
| X | Resident fish | | O & M | + | Biodiversity/genetics |
| | Wildlife | | Production | + | Population dynamics |
| | Oceans/estuaries | + | Research | X | Ecosystems |
| | Climate | + | Monitoring/eval. | + | Flow/survival |
| | Other | X | Resource mgmt | | Fish disease |
| | | + | Planning/admin. | + | Supplementation |
| | | | Enforcement | | Wildlife habitat en- |
| | | | Acquisitions | | hancement/restoration |

**Other keywords**.

Hydropower mitigation, habitat enhancement/restoration/evaluation, fish entrainment, fish passage, ecological interactions, reservoir modeling, IFIM river modeling, hydrosystem operation, lake rehabilitation, mDNA stock identification.

## Section 3. Relationships to other Bonneville projects

| Project # | Project title/description | Nature of relationship |
|---|---|---|
| 9401000 | MFWP- Libby Reservoir Excessive Drawdown | Habitat Enhancement |
| 9608702 | MFWP- Focus Watershed | Native Species Recovery |
| 8806500 | IDFG-Kootenai River Fisheries Investigations | White Sturgeon Revovery |
| 8806400 | KTI – White Sturgeon Experimental Aquaculture | White Sturgeon Recovery |
| 8346500 | Libby and Hungry Horse Modeling Technical Analysis | Reservoir Modeling |
| 9404900 | Kootenai River Ecosystem Improvement Study | Ecosystem Function |

## Section 4. Objectives, tasks and schedules

### *Objectives and tasks*

| Obj 1,2,3 | Objective | Task a,b,c | Task |
|---|---|---|---|
| 1 | Incorporate results of the NPPC public scoping process and council direction into the Libby Mitigation Plan to compensate for fisheries losses brought about by the construction and operation of Libby Dam. | a | Organize a citizen's advisory committee to help the Mitigators implement program actions listed in Plan. Select Advisory Committee from a cross-section of users groups and constituents. Conduct further scoping of draft plan prior to submission to NPPC. |
| 1 | | b | Upon approval by NPPC, implement habitat enhancement, fish passage improvements, off-site mitigation and monitoring as established in the Libby Fisheries Mitigation and Implementation Plan. |
| 2 | Calibrate riverine component of Kootenai system model(IFIM model). Establish biologically sound river operations. Link to | a | Complete analysis of habitat utilization by rainbow trout and mountain whitefish in the Kootenai River from Libby Dam |

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|---|---|---|---|
| | existing reservoir model, which will allow evaluation of operational tradeoffs between reservoir and river. | | to Bonners Ferry (Sections 1 and 2). |
| 2 | | b | Complete hydraulic calibrations of IFIM model using data from Kootenai River transects. |
| 2 | | c | Calibrate completed PHABSIM (RHABSIM) modell |
| 2 | | d | Quantify amount of available habitat for target species in Kootenai River from Libby Dam to Kootenay Lake under various operational strategies. |
| 2 | | e | Determine microhabitat selection of Kootenai River Bull Trout and incorporate HSI data into IFIM model. |
| 2 | | f | Complete final IFIM report. |
| 2 | | g | Develop interface between existing reservoir model (LRMOD) and completed riverine model (RHABSIM). |
| 3 | Define river operations required to mitigate losses of Kootenai River macrozoobenthos attributed to river regulation | a | Determine varial zone area of the Kootenai River associated with ramping operations |
| 3 | | b | Quantify seasonal losses of macrozoobenthos in the Kootenai River during ramping periods. Establish seasonal operational guidelines to minimize impacts. |
| 4 | Complete pilot mitigation projects in the Kootenai Watershed to determine the cost effectivenes of mitigation strategies and help guide future actions that compensate for fisheries losses caused by the construction and operation of Libby Dam. | a | Complete pilot mitigation projects according to established timetables. |
| 4 | | b | Establish site-specific project designs, budgets and timelines for completion of projects listed in the plan. |

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| 4 | | c | Identify projects not previously listed in the Mitigation Plan that will enhance native and gamefish species in the Kootenai Watershed |
| 4 | | d | Conduct pre- and post-treatment data collection for comparison. |
| 5 | Continue efforts to quantify and document life history data for Kootenai River burbot populations. Continue to refine restoration techniques. | a | Enumerate burbot with SCUBA transects and collect spawning burbot from the Libby Dam stilling basin during the months of January, February and March. |
| 5 | | b | Artificially culture burbot to a stage where they are eating solid food. |
| 5 | | c | Review the feasibility of stocking burbot in closed basin Kootenai valley lakes |
| 5 | | d | Continue to collect burbot tissue for mitochondrial DNA analysis. |
| 5 | | e | Determine distribution, timing of spawning, and habitat use by all life stages of burbot in the Kootenai River from Libby Dam to the Idaho line. |
| 6 | Quantify white sturgeon populations in Montana portions of the Kootenai River. Investigate habitat requirements of juvenile hatchery sturgeon and determine availability of habitat in Montana. | a | Determine habitat use of juvenile white sturgeon in Montana using SCUBA transects, hook and line surveying and radiotelemetry |
| 6 | | b | Conduct beam trawling efforts for egg and larval fish in Idaho and British Columbia portions of the Kootenai River. |
| 6 | | c | Determine habitat requirements of larval, juvenile and adult white sturgeon in Montana portions and investigate recovery options. |
| 6 | | d | Continue participation in the White Sturgeon recovery team. |
| 7 | Continue investigating limiting factors of salmonid populations in the lower Kootenai River (Kootenai Falls to Idaho | a | Install screw trap in Yaak River to determine juvenile outmigrant abundance. |

| | | | |
|---|---|---|---|
| | border). Address and implement actions that will enhance this fishery | | |
| 7 | | b | Explore habitat enhancement (spawning, rearing) in principal tributaries. |
| 7 | | c | Conduct electrofishing population estimates in mainstem Kootenai River and principal tributaries (O'Brien and Callahan creeks). Determine recruitment to Kootenai River. |
| 7 | | c | Contract stream rehabilitation project that will meet fisheries enhancement objectives |
| 7 | | e | Post-treatment monitoring of habitat projects. |
| 8 | Monitor use of mainstem Kootenai River and tributaries for spawning and rearing by fluvial burbot, cutthroat and bull trout. | a | Monitor tributary use of river-dwelling bull trout in the Montana portion of the Kootenai River. |
| 8 | | b | Describe the magnitude of the spawning migration of trout into O'Brien and Callahan creeks and the recruitment of fry from these spawning events back into the Kootenai River. |
| 8 | | c | Continue rainbow redd counts below Libby Dam |
| 9 | Document entrainment of fish through Libby Dam during flow events greater than 20,000 cfs. | a | Monitor entrainment of fish through Libby Dam. |
| 9 | | b | Measure draft tube velocities and develop/determine relationship to disharge and reservoir elevation. |
| 9 | | c | Incorporate >20 kcfs entrainment data points into the existing entrainment model (Skaar et al. 1996) |
| 9 | | d | Investigate feasability of development and installation of kokanee salmon deterrent structure on the face of Libby Dam |
| 10 | Monitor zooplankton and | a | Monitor seasonal and annual |

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|---|---|---|---|
| | gamefish populations in Koocanusa Reservoir. | | changes in fish abundance in near-shore zones by seasonal gillnetting. |
| 10 | | b | Conduct annual estimate of population numbers of each age class of kokanee(hydroacoustics).. |
| 10 | | d | Monitor burbot movement in Libby Reservoir |
| 10 | | d | Monitor zooplankton populations in the reservoir. |

### *Objective schedules and costs*

| Objective # | Start Date mm/yyyy | End Date mm/yyyy | Cost % |
|---|---|---|---|
| 1 | 5/1995 | 5/1998 | 6.00% |
| 2 | 8/1995 | 5/1998 | 10.00% |
| 3 | 4/1994 | 5/1998 | 6.00% |
| 4 | 5/1995 | 5/2055 | 40.00% |
| 5 | 10/1994 | 2/2000 | 7.00% |
| 6 | 10/1994 | 8/2004 | 6.00% |
| 7 | 10/1994 | 8/2010 | 5.00% |
| 8 | 10/1994 | 8/2050 | 5.00% |
| 9 | 10/1992 | 2/2000 | 10.00% |
| 10 | 8/1983 | 8/2050 | 5.00% |
| | | | TOTAL 100.00% |

**Schedule constraints.**
None

**Completion date.**
This mitigation program was designed as a long-term commitment to mitigate for the loss statement. Estimated completion date 2055.

## Section 5. Budget

### *FY99 budget by line item*

| Item | Note | FY99 |
|---|---|---|
| Personnel | | $143,609 |
| Fringe benefits | | $46,795 |
| Supplies, materials, non-expendable property | Includes Equipment | $50,232 |

| | | |
|---|---|---|
| Operations & maintenance | | $9,904 |
| Capital acquisitions or improvements (e.g. land, buildings, major equip.) | | $ 0 |
| PIT tags | # of tags: | |
| Travel | | $24,427 |
| Indirect costs | | $38,536 |
| Subcontracts | | $13,490 |
| Other | Watershed enhancement efforts | $173,007 |
| **TOTAL** | | $500,000 |

***Outyear costs***

| **Outyear costs** | **FY2000** | **FY01** | **FY02** | **FY03** |
|---|---|---|---|---|
| Total budget | $600,000 | $600,000 | $600,000 | $600,000 |
| O&M as % of total | 51.65% | 50.00% | 50.00% | 50.00% |

## Section 6. Abstract

Libby Dam, completed in 1972, interrupted the second largest tributary to the Columbia River by creating the 90-mile Libby Reservoir. The primary benefits of this project are power production (91.5%), flood control (8.3%) and other (0.2%). Reservoir surface elevation ranges from 2,287 feet msl to 2,459 feet msl (full pool). Between 1974 and 1996, drawdowns averaged 112.44 feet, with a maximum of 152 feet. Libby Reservoir inundated 109 miles of the mainstem Kootenai River and 40 miles of critical, low gradient tributary habitat. Annual drawdowns affect revegetation of the reservoir varial zone, resulting in a littoral zone of nondescript cobble/mud/sand bottom with limited available structure and limited biological production. River operations for power production cause rapid flow fluctuations (as much as 400% change in daily discharge), which are inconsistent with the normative river concept. Primary objectives of this project are to 1) Correct impacts caused by hydropower operations and mitigate fisheries losses attributed to the construction and operation of Libby Dam using watershed-based, habitat enhancement, fish passage improvements and offsite measures, 2) Integrate computer models into a watershed framework using MFWP's quantitative reservoir model (LRMOD), Integrated Rule Curves (IRC), Instream Flow Incremental Methodology (IFIM) and Libby Dam fish entrainment model (ENTRAIN). Implement operational changes, and 3) Recover native resident species including the endangered Kootenai River white sturgeon, bull trout, westslope cutthroat trout, interior redband rainbow trout, and burbot. A loss statement, site-specific mitigation actions, and monitoring strategies were compiled in the Libby Mitigation and Implementation Plan.

## Section 7. Project description

### a. Technical and/or scientific background.

Completion of Libby Dam in 1972 lead to profound biological and physicochemical changes in the Kootenai Subbasin, the second largest tributary to the Columbia River (Woods 1982; Chisholm et al. 1989; Skaar et al. 1996; Snyder and Minshall 1996). Libby Dam terminated upstream fish migrations and caused a discontinuity between fish communities above and below the dam. Libby Reservoir inundated 109 miles of the mainstem Kootenai River and 40 miles of highly productive, low-gradient tributary stream habitat (MFWP, CSKT and KTOI 1997). Annual reservoir operations resulted in extreme fluctuations in reservoir surface area and volume and river stage, effecting all biological trophic levels in the impoundment and river downstream (Marotz et al. 1996). Reservoir fluctuations affect revegetation of the reservoir varial zone, which results in a littoral zone of nondescript cobble/mud/sand bottom with limited available structure. River operations for power cause rapid flow fluctuations (as much as 400% change in daily discharge) which are inconsistent with the normative river concept (ISAB 1997) and create a wide varial zone that is biologically unproductive (Perry and Huston 1983; Cushman 1985; Hauer and Stanford 1997).

Fish populations throughout the Kootenai River Drainage have demonstrated responses indicative of ecosystem collapse (Partridge 1983; Anders 1993; Anders 1994; Paragamian 1994; Williams 1961). Libby Dam has converted the Kootenai River from a lotic to lentic environment, with species responses validating this change. Westslope cutthroat and rainbow trout captured during annual gillnetting on Libby Reservoir have declined significantly from early post-impoundment levels of 10% and 14% to current levels of 0.2% and 0.3% of the total catch. Conversely, non-game species such as northern squawfish and peamouth chub (not abundant pre-impoundment) have increased significantly in gill net catches to comprise up to 87 percent of the total catch (Chisholm et al. 1989; Dalbey et al. 1997). Similar impacts have been observed in the tailwater below Libby Dam. Barriers have been deposited in critical spawning tributaries to the Kootenai River through the annual deposition of bedload materials (sand, gravel, and boulders) at their confluence with the river (Marotz et al. 1988). The Kootenai River (pre-impoundment) contained sufficient hydraulic energy to annually remove these deltas, whereas sufficient hydraulic energy is lacking from the post-impoundment Kootenai River. Reversal of the Kootenai River hydrograph and alteration of the thermograph have caused impacts typical of tailwaters. Native fish populations that have been reduced due to impoundment include burbot (which are an estimated 10% of pre-impoundment levels, with current hoopnet catches of 0.002-0.168-fish/hoopnet hour), and westslope cutthroat trout (populations have been in decline based on 24 years of population estimates (Huston et al. 1984, Dalbey et al. 1997)). In 1973, 44 percent of trout captured were westslope cutthroat, with angler catch rates recorded at 0.5 fish/hour, ranking the Kootenai River among other blue ribbon trout streams in Montana. Estimates in 1994 document significant population reductions, with less than 5 percent of the trout captured being

westslope cutthroat trout (MFWP data files). White Sturgeon populations were listed as endangered in the Kootenai River on October 6th, 1994, with very little recruitment since 1974 (U.S. Federal Register Vol. 59, No. 171). Recovery programs initiated in 1993 and formally addressed in the Kootenai River White Sturgeon Recovery Plan (USFWS 1997) have failed to document any wild sturgeon recruitment to this population.

**b. Proposal objectives**.

GOAL: Rebuild weak, but recoverable, native fish populations of the Kootenai Basin injured by the hydropower system to sustainable levels.

OBJECTIVES:

1) Incorporate results of the NPPC public scoping process and council direction into the Final Libby Mitigation Program. A completed document will be available and include: Quantification of fish losses assosicated with the construction and and operation of Libby Dam (tributary streams, mainstem Kootenai above and below Libby Dam), Biological cosequences of hydropower operations, management considerations and potential mitigation projects to enhance native species in the Kootenai Basin. A final draft is currently available (MFWP, CSKT and KTOI. 1997. Fisheries mitigation and implementation plan for losses attributable to the construction and operation of Libby Dam. **Draft Report**: Montana Department of Fish, Wildlife and Parks, Confederated Salish and Kootenai Tribes and the Kootenai Tribe of Idaho. Prepared for Bonneville Power Administration. Project No. 83-467).

2) Specific operational guidedlines that incorporate ecologically viable ramping rates and weighted usable area (WUA) for target fish species at various flow regimes will be incorporated in the Libby Dam/ Kootenai River investigations annual report (completion date 4/98). This report will complete the Kootenai River Instream Flow Incremental Methodology (IFIM) study. Specific accomplishments of this report will include Habitat Suitability Curve establishment for juvenile and adult rainbow trout and mountain whitefish allowing for habitat quantification of WUA at various Libby Dam discharges. Furthermore, the completed model will provide a template to quantify WUA values for juvenile Kootenai River White Sturgeon, Bull Trout and macrozoobenthos (OBJECTIVE 4) (by trophic guild and seasonal life stage).

4) Complete mitigation projects in the Kootenai Watershed to compensate for fisheries losses incurred from the construction and operation of Libby Dam. Specific projects that will be completed in 1999 include:

    a) Rehabilitation of Carpenter Lake to remove illegally introduced non-native species that compete and prey on native species followed by reintroduction of native westslope cutthroat trout.

b) Reconstruction of stream channels in historic native westslope cutthroat, inland rainbow and bull trout watersheds that have been impacted by various land-use practices. GOAL is to reclaim linear stream habitats eliminated by inundation of Libby Dam. The following are priority projects to be completed in 1998.

* Bobtail Creek – Rehabilitate over 2,900 linear feet of channel to decrease width to depth ratio (W:D), reduce sediment loading caused by livestock use (project area will be fenced year-round), revegitation with native plants to provide soil stabilization and canopy cover, increase instream habitat hetrogeniety (boulders and large woody debris (LWD), provide spawning gravel entrapment conditions, increase juvenile rearing microhabitat. Project completion date = 10/98. Native species benefited = westslope cutthroat trout.

* Pipe Creek – Rehabilitate 780 linear feet of channel to decrease W:D, reduce sediment loading caused by riparian vegitation removal (urban development), revegitation with native plants to provide soil stabilization and canopy cover, increase instream habitat hetrogeniety (boulders and large woody debris (LWD), provide spawning gravel entrapment conditions, increase juvenile rearing microhabitat. Project completion date = 10/98. Native species benefited = westslope cutthroat and inland rainbow trout.

* Libby Creek – Rehabilitate approximately 6000 linear feet of channel to decrease W:D, reduce sediment loading caused by riparian vegitation removal (urban development and livestock overutilization), revegitation with native plants to provide soil stabilization and canopy cover, increase instream habitat hetrogeniety (boulders and large woody debris (LWD), provide spawning gravel entrapment conditions, increase juvenile rearing microhabitat. Phase I project completion date = 11/98. Native species benefited = westslope cutthroat and bull trout, burbot.

* Libby Field Station Spring Creek – Rehabilitate approximately 1320 linear feet of channel to decrease W:D, reduce sediment loading caused by bank sloughing, increase instream habitat hetrogeniety (boulders and large woody debris (LWD), provide spawning gravel entrapment conditions, increase juvenile rearing microhabitat. Comprehensive project objective is to provide a wild captive brood stock for inland rainbow trout in the Kootenai Basin. Phase II will involve rehabilitation of small lakes connected to the Libby Field Station Spring Creek on Libby Field Station (MFWP property) and phase III will entail gamete collection for conservation aquiculture followed by outplanting to closed basin lakes and/or genetic swamping of stream populations. This will occur following sucessful establishment of genetically pure inland rainbow stock. Phase I project completion date = 11/98. Native species benefited = inland rainbow trout.

All pretreatment survey data (fish density and species assemblage, macroivnertebrate trophic guild composition, water temperature, stream dimension, pattern, profile and sediment loading) have been collected, entered and analyzed to determine cost effectiveness of varous treatment options. Only projects projected to provide

measureable improvement in the aforementioned biological indicies will be implemented. Post-treatment evaluations of indicies are established in rigorous data collection protocols followed by independent evaluation of project success criteria. Habitat enhancement project evaluations will be detailed in annually completed progress reports.

5) Aquaculture techniques for burbot *Lota lota* have never been established in the literature. Gametes from wild Kootenai River burbot will be collected during the spawning period (2/98). These gametes will be fertilized and incubated at the MFWP owned Libby Field Station facility in Libby Montana. The following fish culture steps will be documented:
   * Gamete collection techniques
   * Fertilization procedures (replicates of different techniques will be provided)
   * Water temperature and time to hatch
   * Preservation of developmental phases of egg through juvenile burbot.
   * Hatching success (% eye-up and % hatch)
   * Growth rates
   * General Comments
   * Solid food utilization (using several varieties of experimental food)

Completion of experiment will be when larval burbot have been sucessfully established on solid food and mortality curve stabilizes. All results will appear in the 1998 annual report and peer reviewed journals in 1999.

6) Recovery efforts for white sturgeon populations in the Kootenai River will include beam trawling (beam trawl dimensions = 3m X 1m X 10 m and 2m X ½m X 3.65 m) for egg and larval sturgeon throughout areas of known spawning. Effort will be comprised of a minimum of 10 trawling days during the months of May, Jun, Jul and Aug. A minimum of 10 days of activity will be spent quantifying juvenile sturgeon abundance and habitat utilization on Montana portions of the Kootenai. Specific capture methods will include (but not be limited to) gill and trammel nets, set lines and traditional angling gear and SCUBA. A maximum of five adult and juvenile fish will be affixed with radio transmitters with locations monitored four times monthly.

   Outcomes of this research will be data to better elucidate sturgeon population estimates, determine abundance and habitat utilization of sturgeon in Montana portions of the Kootenai River.

7) Limiting factors to native salmonid populations in the Kootenai River (below Kootenai Falls) will be investigated using the following techniques. The principal objective is to determine if salmonid populations are recruitment limited.

   *Screw trapping operation on Yaak River and O'Brien Creek to quantify outmigrant abundance during May through September.

*Population estimates on two reaches mainstem Kootenai River (approximately 3220 m sections).
* Spawing and rearing habitat inventories in principal tributaries (Callahan, Ruby, Star, O'Brien, Yaak) will occur during the months of August and September.

8) Mainstem Kootenai River and principal tributaries will be monitored for spawning and rearing by fluvial burbot rainbow trout and bull trout. The following objectives will be accomplished.
* Mainstem rainbow trout redds will be counted weekly from 4-20 through 5-31 between Alexander Creeek and the Fisher River.
*Upstream migrant trap will be operated on Bobtail Creek from 4-1 through 5-31.
* Bull trout redd counts will be completed on a watershed basis on the following streams: Quartz Creek, W. Fork Quartz, O'Brien Creek, Pipe Creek, E. Fork Pipe, Bear Creek, Keeler Creek, N. Fork Keeler, S. Fork Keeler, Grave Creek, Clarence Creek, Blue Sky Creek, Weasel Creek, Wigwam River (U.S.), Wigwam River (Canada). Dates of redd counts will vary from 9-25 through 10-25. Data collected will update the Kootenai Basin Bull trout redd count database which has been the principal bull trout monitoring tool since 1983 (Dalbey et al. 1997). Results will be presented in the 1998 annual report.

9) Entrainment of fish through Libby Dam will be documented during flow events greater than 20,000 cfs. The following sampling targets will be achieved.

* Kokanee (particularly age 0 fish) are susceptible to entrainment during spring runoff due to high forebay fish densities (Skaar et al. 1996). The extent to which entrainment occurs is related to the magnitude of the runoff and the dam discharge during June and July. Monitoring will be conducted from May to July, with specific sampling dates timed to correspond to dam releases for white sturgeon. The initial entrainment model was unable to measure entrainment in flows greater than 20,000 cfs. Therefore, the predictive capability of this model is limited during experimental salmon and white sturgeon flows. Data collected in 1998 will be valuable to allow managers to predict estimated numbers of kokanee salmon entrained through Libby Dam during these experimental flow periods. Furthermore, with the proposed installation of three additional turbines in Libby Dam for white sturgeon recovery (USFWS), entrainment quantification becomes paramount as the potential release of 44,000 cfs could significantly impact Libby Reservoir kokanee populations. Accurate entrainment model runs can provide baseline data allowing for evaluation of screening devices that could be placed on Libby Dam to reduce entrainment.

Specific sampling dates will depend on the timing and magnitude of experimental white sturgeon spawning enhancement flows and Lower Columbia salmon augmentations. However, draft tube nets will be deployed accompanied by forebay hydroacoustic enumeration of kokanee during 24-hr periods pre-ramp up, mid-flow and post-rampdown. Five distinct sampling events (encompassing the three-stage sampling scheme) will occur during May – September.

10) Monitor zooplankton and gamefish populations in Libby Reservoir.

We have selected kokanee, westslope cutthroat trout, rainbow trout and rainbow X cutthroat hybrids as our target gamefish species for LRMOD. Burbot and bull trout are important gamefish, but are not included in the model. The continued monitoring program of reservoir fisheries will alert managers to significant changes if they occur.

Seasonal and annual changes in fish abundance in near shore areas will be assessed by seasonal horizontal gillnetting based on the following reservoir physical parameters:
**Spring (28 nets)** - Reservoir elevation between 2,350 and 2,375 feet and a surface water temperature near $11^{o}C$ ($\pm 2^{o}C$).
**Fall (28 nets)** - Reservoir elevation between 2,459 (full pool) and 2,449 feet and a surface water temperature near $15^{o}C$ ($\pm 2^{o}C$).

Analysis of gillnetting data will be included in the annual report.

Zooplankton monitoring will involve three vertical tows using a 0.3 meter, 153 micron Wisconsin net completed monthly in randomly selected stations of three reservoir areas (Tenmile, Rexford and Canada). Thirty meter tows are done unless water column depth was less than 30 m, in which case, the entire water column is sampled. Orientation {east, west and middle (>100 m from either shore)} for each site was also chosen randomly. All samples were pulled at a rate of 1 m/sec to minimize backwash (Leathe 1982).

## c. Rationale and significance to Regional Programs.

Hydropower related impacts on the Kootenai Watershed are well documented. The Libby Dam Fisheries Mitigation and Implementation Plan for Losses attributed to the Construction and Operation of Libby Dam details quantified fish losses above and below Libby Dam as called for by the FWP. Kootenai white sturgeon are endangered (USFWS 1997); less than 1,500 individuals remain. Bull trout are proposed for listing. The bull trout population below Libby Dam has too few subpopulations to be considered a stable metapopulation. However, the population in the Canadian headwaters of Libby Reservoir is believed to be the strongest metapopulation in existence. Westslope cutthroat trout have been petitioned for listing under ESA. Losses and potential mitigation projects targeted at enhancement of native populations in the Kootenai Basin were compiled in the Libby Mitigation and Implementation Plan. This document was developed as a collaborative programmatic assessment with the Salish and Kootenai Tribes and the Kootenai Tribe of Idaho. Further coordination is conducted with Idaho Fish and Game and British Columbia Ministry of Environment. White Sturgeon Recovery efforts are consistent with the internationally developed White Sturgeon Recovery Plan (USFWS 1997). This program directly addresses the FWP mandate to enhance hydropower impacted fish stocks in the Kootenai Basin through on-the-ground habitat enhancement

efforts that alleviate limiting factors to native species populations. Projects reclaiming critical spawning, rearing, overwintering habitats have been completed, or are ongoing, as pilot mitigation projects. These projects are being completed using grassroots watershed workgroups comprised of landowners, agency, sportsmen's groups and local, state and federal government coalitions.

The IFIM river model will be linked with the existing reservoir model LRMOD to complete the integrated watershed framework. The IFIM research is calibrating simulations of hydraulic conditions (stage/discharge and velocities) and fish habitat from Libby Dam to Kootenay Lake, British Columbia, Canada at various discharges from Libby Dam. An optimization program is scheduled for development to allow managers to assess tradeoffs between the requirements of reservoir and riverine biota, when conflicts occur between reservoir operation and river flow limits as per the FWP. This project provides data used to develop and refine operating protocols for Libby Dam (IRCs), including Tiered Flow augmentation for the recovery of the endangered Kootenai River white sturgeon. The IRC concept has been recognized by the ISG as a tool for restoring normative conditions in rivers below storage projects. The IRCs can be applied to other projects given the necessary data. A simplified version of the models was used during the Columbia Basin System Operation Review process on Dworshak, Grand Coulee and Pend Oreille. This screening model produces qualitative results that can be used to direct field sampling efforts that, in time, will provide the data for quantitative subroutines to construct a full-scale quantitative evaluation model.

## d. Project history

Work to assess the effects of operation on fish populations and lower trophic levels in Libby Reservoir began in 1982. Results were used to develop the quantitative reservoir model LRMOD. The models and preliminary IRCs (called Biological Rule Curves) were first published in 1989 (Chisholm and Fraley 1986). Monitoring of the reservoir biota continued to refine and validate the reservoir model. Development of Integrated Rule Curves and Tiered Flow Augmentation was completed on 1996. The project identified important spawning and rearing tributaries in the U.S. portion of the reservoir and began genetic inventories of species of special concern. Research on the entrainment of fish through the Libby Dam penstocks began in 1990 and was published in 1996. Research on the effects of operations on the river fishery using IFIM techniques was initiated in 1992. Assessment of the effects of river fluctuations on Kootenai River burbot fishery was examined in 1994 and 1995. IFIM studies to determine spawning area available to sturgeon at various river flows were also completed in the Kootenai River below Bonners Ferry. Microhabitat data collection specific to species and life-stage of rainbow trout and mountain whitefish has been incorporated into suitability curves. River cross-sectional profiles, velocity patterns and other fisheries habitat attributes were completed in 1997. Hydraulic model calibrations and incorporation of suitability curves and modification of the model code will reach completion in 1998.

The following is a list of project reports and technical papers. A summary of accomplishments and implementation of adaptive management principals can be found in the abstract of each document. The annual budget of each project is attached as a table below.

Chisholm, I.M. and J.J. Fraley. 1986. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Annual report. Prepared for Bonneville Power Administration by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana. Project No. 83-467.

Chisholm, I.M. and P.D. Hamlin. 1987. 1985 Libby Reservoir angler census. Prepared for Bonneville Power Administration, by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana. Project No. 83-467.

Chisholm, I.M., M.E. Hensler, B. Hansen, D. Skaar. 1989. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Methods and Data Summary 1983-1987. Prepared for Bonneville Power Administration by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana. Project No. 83-467.

Dalbey, S.R., J. DeShazer, L. Garrow, G. Hoffman, and T. Ostrowski. 1997. Quantification of Libby Reservoir levels needed to enhance reservoir fisheries. Methods and data summary, 1988-1996. Draft Report. Montana Department of Fish, Wildlife and Parks - Region 1. Prepared for Bonneville Power Administration. Project No. 83-467.

Hauer, R. 1997. Kootenai river zoobenthos investigation. Kootenai River Fisheries Investigations - Montana. Montana Department of Fish, Wildlife and Parks Region 1. Annual Report to Bonneville Power Administration. Project No. 83-467.

Marotz, B.L. and J.J. Fraley. 1986. Instream flows needed for successful migration, spawning and rearing of rainbow and westslope cutthroat trout in selected tributaries of the Kootenai River. Montana Department of Fish, Wildlife and Parks. Prepared for Bonneville Power Administration. Project Number 85-6.

Marotz, B.L., and J. Fraley. 1986. Instream flows needed for successful migration, spawning and rearing of rainbow and westslope cutthroat trout in selected tributaries of the Kootenai River. Montana Department of Fish, Wildlife and Parks. Prepared for Bonneville Power Administration. Project Number 85-6.

Marotz, B.L., B. Hansen, and S. Tralles. 1988. Instream flows needed for successful migration, spawning and rearing of rainbow and westslope cutthroat trout in selected tributaries of the Kootenai River. Montana Department of Fish, Wildlife and Parks. Prepared for Bonneville Power Administration. Project Number 85-6.

Marotz, B.L., D. Gustafson, C. Althen and B. Lonen. 1996. Model development to establish integrated operational rule curves for Hungry Horse and Libby Reservoirs - Montana. Montana Department of Fish, Wildlife and Parks - Region 1. Prepared for U.S. Department of Energy - BPA. Project number 83-467

MFWP, CSKT and KTOI. 1997. Fisheries mitigation and implementation plan for losses attributable to the construction and operation of Libby Dam. **Draft Report**: Montana Department of Fish, Wildlife and Parks, Confederated Salish and Kootenai Tribes and the Kootenai Tribe of Idaho. Prepared for Bonneville Power Administration. Project No. 83-467.

Perry S. and J. Huston. 1983. Kootenai River Investigations Final Report 1972-1982. Section A. Aquatic Insect Study. Montana Fish, Wildlife & Parks in cooperation with the U.S. Army Corps of Engineers. 112p.

Shepard, B.B. 1985. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Annual Report. Prepared for Bonneville Power Administration by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana.

**Table of annual funding for Project 83-467.**

| Budget Period | Amt. Funded | Modification |
|---|---|---|
| 05-83 - 05-84 | $156,305. | Original |
| 10-83 - 10-84 | $371,311. | Mod 001000203 |
| 09-84 - 04-85 | $112,561. | 4 |
| 05-85 - 05-86 | $292,106. | 5 |
| 08-85 - 11-87 | $231,908. | 6 |
| 09-86 - 03-88 | $472,871 | 76,550.8 |
| 10-87 - 09-88 | $49,696. | 9 |
| 07-88 - 11-88 | $72,826. | 10 |
| 11-88 - 12-88 | 0 | 11 |
| 12-88 - 12-87 | $248,844. | 12 |
| 12-89 - 12-90 | $270,492. | 13 |
| 12-90 - 12-92 | $282,142. | 14 |
| 12-91 - 12-92 | $297,262. | 15 |
| 01-93 - 12-93 | $275,000. | 16 |
| 01-94 - 12-94 | $286,524. | 17 |
| " | $6,939. | 18 |
| 11-94 - 11-95 | $279,715. | 19 |
| " | $4,500. | 20 |
| 11-95 - 11-96 | $298,249. | 21 |
| 11-96 - 11-97 | $310,700. | 22 |

This project established relationship between reservoir operation and biological productivity, incorporated results in the computer model LRMOD. Developed Integrated Rule Curves (IRCs) adopted by NPPC in 1994 but not yet implemented. Developed tiered approach for white sturgeon spawning flows balanced with reservoir IRCs and Snake River salmon biological opinion. The White Sturgeon Recovery Team unanimously supported this strategy. A long-term database was established for monitoring populations of kokanee, bull trout, westslope cutthroat, rainbow and burbot and other native fish species. Long-term monitoring of zooplankton and trophic relationships was similarly established. A model was calibrated to estimate the entrainment of fish and zooplankton through Libby Dam as related to hydro-operations and use of the selective withdrawal structure. The effects of dam operation on benthic macroinvertebrates in the Kootenai River was also assessed (Hauer et al. 1997) for comparison with conditions measured in the past (Perry and Huston 1983) .

Documented successes of pilot mitigation projects include enhancement of westslope cutthroat and rainbow trout populations in Bobtail Creek (tributary to Kootenai River below Libby Dam). Eradication of illegally introduced predators in three Kootenai Basin lakes and reestablishment of native westslope cutthroat trout has been completed thus increasing the range and overall distribution of this species.

**e. Methods**.

Completion of the Kootenai River Instream Flow Methodology (IFIM) study will involve calibration of the HYDSIM, HABSIM subcomponents of the RHABSIM (River HABitat SIMulation) model framework developed under the overall framework of the IFIM and Physical Habitat Simulation (PHABSIM). PHABSIM consists of hydraulic simulation (in this case the IFG4 computer model using a single high flow data set for velocity calibration and two other stage-discharge rating measurements) and habitat simulation with the HABTAT computer model. Calibration of HYDSIM involves utilization of the stream roughness worksheets, velocity graphs and Water Surface Elevation (WSL) with the objective of reproducing the measured velocities and limiting errors in velocity estimates when extrapolating over a range of simulated flows. Calculation of Weighted Usable Area (WUA) at each simulation flow and species life stage will be accomplished following calibration of Habitat Suitability curves or species criteria curves (stepwise polynomial regression). WUA values for Kootenai River rainbow trout and mountain whitefish (adult and juvenile stages), aquatic macroinvertebrates, bull trout and white sturgeon under different simulated discharges from Libby Dam will be evaluated seasonally to determine hydropower impacts. Subroutines from existing reservoir model LRMOD will be written by Dr. Craig Althen to link the two models allowing evaluation of tradeoffs and ecological impacts of operational schemes on the river and reservoir environments.

Investigations into limiting factors of native, resident, fluvial populations combine diverse field evaluation techniques. These include mark-recapture estimates in impaired reaches as well as relic reaches of the same or similar stream reach. Assumptions involved in this approach are that reaches are long enough to include all habitat types and

that movement in and out of the reach is extremely limited or nonexistent (Ricker 1975). Also, reaches and associated fish parameters are representative of the entire stream. Parameters evaluated are population densities, species assemblages and composition, fish growth and age, condition factors, and biomass estimates. Historic data for the reach or a comparative reach is utilized (if available) and assessment of the reaches carrying capacity or biological potential is evaluated.

Stream habitat restoration projects involve collection of stream survey information to establish accurate dimension, pattern and profile of individual project reaches. These data include velocity, depth, slope, width, channel materials, discharge and sediment supply. Level III (Rosgen 1996) field evaluation of streams are conducted which determine the state, stability, and "health" of the system.

Habitat manipulation activities are undertaken following critical evaluation of potential benefits to native species and identification of limiting factors. In general, the following criteria are used to evaluate success or failure of project: changes in standing stock, growth, proportional stock density, relative weight values, catch or harvest rates, angler satisfaction and permanency of improvements. This project offers a unique approach to enhance fish stocks affected by hydropower in the Kootenai Basin through on-the-ground habitat enhancement efforts and pre- and post-treatment data collection. Monitoring strategies have been established to determine a long-term success/failure criteria for evaluation of habitat enhancement efforts. Stream restoration and passage improvement are evaluated based on physical and biological changes. Physical parameters are evaluated using Rosgen stream typing (Rosgen 1996) to determine stream recovery potential and hydraulic heterogeneity of habitat structures, photopoints, and substrate analysis (sediment scoring and coring) in treatment areas. Pre- and post-treatment measurements of fish community structure (standing stock and species relative abundance), age/growth relationships (otoliths and scales) and condition factor (weight/size), and increased spawning utilization (redd/spawnwer counts) are used to assess fish recovery.

Lake restoration projects follow standard rehabilitation protocols (Greenback 1941). Historic fish and invertebrate data are thoroughly reviewed to determine species assemblage changes that have occurred. Parameters include population densities, species composition, fish growth and age, condition factors, and biomass estimates. Physical factors (geographic location, water exchange rate, eutrophication, seasonal oxygen and temperature profiles) are used to assess whether the lake has potential to expand the range of native species, create a genetic reserve or provide angling opportunity. Lakes are chemically rehabilitated using rotenone to remove nonnative (often illegally introduced) species that compete or prey on native populations. Following rehabilitation, native species from captive brood stock are planted back into the lake the spring following rehabilitation.

**f. Facilities and equipment**.

The Libby Field Station of MFWP has two office buildings containing office space, wet lab and computer equipment sufficient for project staff. Remnants of the old fish hatchery provide facilities for meeting experimental aquiculture objectives. A workshop and boatshed are situated near the office buildings on the state property. State vehicles and workboats are available for project use. Electrofishing equipment (boat-mounted, bank and backpack units), surveying and GPS equipment, SCUBA gear, lake and river sampling devices for sampling/monitoring all trophic levels are available at the site. A bobcat with apparatus designed for habitat enhancement work is time-shared with the Hungry Horse Mitigation Program. Minor tools and equipment are included in the project budget.

**g. References**.


Anders, P. J. 1993. Natural spawning of white sturgeon in the Kootenai River. Annual Hatchery Report FY1993, Report A. Kootenai Tribe of Idaho for Bonneville Power Administration, Portland, OR.

Anders, P. J. 1994. Kootenai River tributary kokanee spawning ground survey. Annual Hatchery Report FY1994, Report C. Kootenai Tribe of Idaho for Bonneville Power Administration, Portland, OR.

Chisholm, I.M. and J.J. Fraley. 1986. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Annual report. Prepared for Bonneville Power Administration by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana. Project No. 83-467.

Chisholm, I.M., M.E. Hensler, B. Hansen, D. Skaar. 1989. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Methods and Data Summary 1983-1987. Prepared for Bonneville Power Administration by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana. Project No. 83-467.

Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management. 5:330-339

Dalbey, S.R., J. DeShazer, L. Garrow, G. Hoffman, and T. Ostrowski. 1997. Quantification of Libby Reservoir levels needed to enhance reservoir fisheries. Methods and data summary, 1988-1996. Draft Report. Montana Department of Fish, Wildlife and Parks - Region 1. Prepared for Bonneville Power Administration. Project No. 83-467.

Greenback, J. 1941. Selective poisoning of fish. Transactions of American Fisheries Society. 70:80-86

Hauer, R. and J.A. Stanford 1997. Kootenai river zoobenthos investigation. Kootenai River Fisheries Investigations - Montana. Montana Department of Fish, Wildlife and Parks Region 1 (Open File Report). Annual Report to Bonneville Power Administration. Project No. 83-467.

Huston, J. E., P. Hamlin and B. May. 1984 Lake Koocanusa Investigations – Final Report 1972-1983. Montana Department of Fish, Wildlife and Parks – Region 1 in cooperation with Seattle District ACOE.

ISAB. 1997

Leathe, S.A. and P.J. Graham. 1982. Flathead Lake fish food habits study. Final Report. Prepared for the Environmental Protection Agency by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana.

Marotz, B.L., B. Hansen, and S. Tralles. 1988. Instream flows needed for successful migration, spawning and rearing of rainbow and westslope cutthroat trout in selected tributaries of the Kootenai River. Montana Department of Fish, Wildlife and Parks. Prepared for Bonneville Power Administration. Project Number 85-6.

Marotz, B.L., D. Gustafson, C. Althen and B. Lonen. 1996. Model development to establish integrated operational rule curves for Hungry Horse and Libby Reservoirs - Montana. Montana Department of Fish, Wildlife and Parks - Region 1. Prepared for U.S. Department of Energy - BPA. Project number 83-467

MFWP, CSKT and KTOI. 1997. Fisheries mitigation and implementation plan for losses attributable to the construction and operation of Libby Dam. **Draft Report**: Montana Department of Fish, Wildlife and Parks, Confederated Salish and Kootenai Tribes and the Kootenai Tribe of Idaho. Prepared for Bonneville Power Administration. Project No. 83-467.

Paragamian, V. L. 1994. Kootenai River fisheries investigations: stock status of Burbot and Rainbow Trout, and fisheries inventory. 1994 annual work plan, draft. IDFG, Coeur d'Alene, ID.

Partridge, F. 1983. Sub project IV: River and stream investigations, Study IV: Kootenai River fisheries investigations., Idaho Department of Fish and Game, Boise, Idaho.

Perry S. and J. Huston. 1983. Kootenai River Investigations Final Report 1972-1982. Section A. Aquatic Insect Study. Montana Fish, Wildlife & Parks in cooperation with the U.S. Army Corps of Engineers. 112p.

Rosgen D.L. 1996. Applied fluvial morphology. Wildland Hydrology. Pagosa Springs, CO. Printed Media Companies, Mpls, MN.

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Snyder, E. B. and G. W. Minshal. 1996. Ecosystem metabolism and nutrient dynamics in the Kootenai River in relation to impoundment and flow enhancement for fisheries management. Stream Ecology Center, Department of Biological Sciences, Idaho State University, Pocatello, Idaho.

USFWS. 1997

Woods, P. F. and C. M. Falter. 1982. Limnological investigations: Lake Koocanusa, Montana Part 4: factors controlling primary productivity [special report 82-15]. Prepared for: USACE, Seattle, WA.

## Section 8. Relationships to other projects

As members of the Endangered Kootenai River White Sturgeon Recovery Team, this project conducts recovery actions and monitoring activities. These activities include benthic, mid-water and surface beam trawling. A Section 10 (ESA) permit was issued to MFWP researchers to extend larval and juvenile white sturgeon sampling in Montana portions of the Kootenai River. IDFG and KTOI scientists sampling in Montana portions of the Kootenai River work under this section 10 permit. MFWP scientists working in Idaho portions of the Kootenai River are working under IDFG section 10 permit. These efforts are conducted with assistance from IDFG and KTOI biologists and technicians, since marking, aging, and radio tagging must be coordinated to ensure consistent data collection. Weekly/monthly meetings with IDFG and KTI guarantee a programmatic approach to sturgeon recovery throughout the Kootenai basin.

Collaborative habitat and native, resident species restoration in the Kootenai Watershed is carried out with the Focus Watershed Coordinator and the Libby Reservoir Excessive Drawdown Program. This project and the focus watershed project carry out facilitation of watershed-based habitat restoration programs with pertinent agency and citizen groups. Cost-share arrangements are promoted with public and private organizations. Implementation of pilot Libby Dam Mitigation habitat projects are carried out concurrently with this project and the Libby Reservoir Excessive Drawdown Program. Actions must comply with the Montana Environmental Protection Act, (consistent with NEPA requirements), Army Corps of Engineers 404 permits, state water quality 3A permits, streambank protection 124 and/or 310 and other applicable state, tribal or county regulations.

## Section 9. Key personnel

# Steve Dalbey

Professional Objective

Continued professional employment in fisheries management to further develop and promote sound fisheries management practices designed to conserve, protect and enhance natural resources.

Education

1991 - 1994 Montana State University Bozeman, Montana
Master of Science – Fish and Wildlife Management

1983 - 1988 Montana State University-B Billings, Montana
Bachelor of Science – Biology (Animal Physiology)

Professional experience

1995 – Current Montana Fish, Wildlife and Parks Libby, MT
Fisheries Biologist (Special Projects)

11) Developed Kootenai River Fisheries Mitigation Program
12) Execute Kootenai Basin recovery efforts of native species and watershed habitat enhancement program
13) Lead research investigating limiting factors of native and sport fish populations
14) Coordinate and assist in interagency and internationally comprised, Kootenai River White Sturgeon (endangered) steering/recovery team
15) Direct Kootenai River Instream Flow Incremental Methodology Study

- Provide fisheries management statistics of fish assemblage composition and populations dynamics for Kootenai River and Libby Reservoir and associated tributaries

1991 – 1994 Montana State University Bozeman, MT
Graduate Student

16) Determined impacts of electrofishing on long-term growth and survival of wild rainbow trout
17) Investigated relationships between pulse shape and incidence and severity of spinal injury in rainbow trout
18) Evaluated healing of electrofishing-induced spinal injuries
19) Presented research to 1995 National (Nova Scotia) and Montana Chapter AFS
20) Completed MS Thesis entitled: “Effects of Electrofishing on Long-Term Growth and Mortality of Wild Rainbow Trout”

1993 – 1995 Montana Fish, Wildlife and Parks Billings, MT
Fisheries Technician

21) Sampled and assessed fisheries population parameters of lakes and ponds of South Central Montana
22) Supervised and participated in fisheries surveys of Absoraka-Beartooth Wilderness lakes.
23) Completed drainage-wide management summaries

- Quality control of data collection, entry, analysis and summaries.

1989 – 1991 Montana Fish, Wildlife and Parks Billings, MT
Fisheries Technician

24) Developed study design, sampling protocol and questionnaire for large-

scale angler/creel survey

25) Completed statistical analysis and final summary of 1,700 angler interviews and provided management recommendations

- Drafted proposals and sucessfully received funding for continued research of socioeconomic and biological impacts of winter fishery

Publications

Dalbey, S.R., J. DeShazer, L.Garrow, G. Hoffman, and T. Ostrowski. 1997. Quantification of Libby Reservoir levels needed to enhance reservoir fisheries. Methods and data summary, 1988-1996. **Draft Report**. Montana Department of Fish, Wildlife and Parks - Region 1. Prepared for Bonneville Power Administration. Project No. 83-467.

Dalbey, S.R. and B.L. Marotz. 1997. Fisheries mitigation and implementation plan for losses attributable to the construction and operation of Libby Dam. **Draft Report**: Montana Department of Fish, Wildlife and Parks, Confederated Salish and Kootenai Tribes and the Kootenai Tribe of Idaho. Prepared for Bonneville Power Administration. Project No. 83-467.

Dalbey, S.R., T.E. McMahon and W. Fredenberg. 1996. Effect of electrofishing pulse shape and electrofishing-induced spinal injury on long-term growth and survival of wild rainbow trout. North American Journal of fisheries Management.16:560-569

McMahon, T.E., S.R. Dalbey, S.C. Ireland, J.P. Magee and P.A. Byorth. 1996. Field evaluation of visible implant tag retention by brook trout, cutthroat trout, rainbow trout and arctic grayling. North American Journal of fisheries Management. 16:921-925

Awards

American Fisheries Society Most Significant Paper Award 1997. North American Journal of Fisheries Management.

National Science Foundation Grant Recipient. 1985. Reproductive Characteristics of Pika (*Ochotona princeps*)

Additional professional activities

Kootenai River Network

Libby Area Conservancy District
Bobtail Watershed Workgroup

Kootenai River White Sturgeon Recovery Steering Committee

Professional memberships

American Fisheries Society – Montana Chapter

American Fisheries Society – National Chapter

Montana Department of Fish, Wildlife and Parks – Electrofishing Committee

**GREGORY C. HOFFMAN**
**FISHERIES RESEARCH SPECIALIST**
Montana Department of Fish, Wildlife and Parks
475 Fish Hatchery Road
Libby, MT 59923

**DEGREES EARNED**

University of Wisconsin - Stevens Point; Stevens Point, WI
Master of Science *in* Fisheries, August, 1994

South Dakota State University; Brookings, SD
Bachelor of Science *in* Wildlife and Fisheries Sciences, June, 1990

University of Minnesota - Crookston; Crookston, MN
Associate of Applied Science *in* Natural Resources Conservation, June, 1986

**CURRENT RESPONSIBILITIES**

Perform professional research, analysis and documentation to assess the biological effects of dam operation in the Columbia Basin. Operate the reservoir model (LRMOD) and the IFIM and AEA models. Under the guidance of the program officer and project biologist, evaluate Montana's Kootenai River White Sturgeon recovery efforts. Initiate and assist Libby Fisheries Mitigation project with field, office, and laboratory duties required to research, monitor and mitigate for the construction and operation of Libby Dam.

**RECENT EMPLOYMENT**

Environmental Careers Organization Associate - Fisheries Biologist; E.C.O., Seattle, WA.; 05/94 - 12/95
@ Bureau of Land Management, Challis Resource Area; Salmon, ID; 05/94 to 05/95
@ Bureau of Land Management, Great Divide Resource Area; Rawlins, WY; 05/95 to 12/95

**EXPERTISE**

- Well-versed in fisheries theories, principles, and methods of research, management, and conservation.
- Fisheries statistics and population dynamics analysis.
- Scientific and technical literature preparation and use.
- Fisheries and other environmental sampling methods and data analysis.
- Stream habitat enhancement.
- Personal computers and application programs, computer habitat simulation models, and GPS/GIS applications.

1994: BLM "Proper Functioning Condition" Workshop - Casper, Wyoming
1995: USFS "R1/R4 Stream Inventory Methodology" - Salmon, Idaho
1995: USFS "R1/R4 FBase Stream Inventory Data Analysis" - Challis, Idaho
1996: AFS Public Outreach Symposium - Bozeman, Montana
1996: SCUBA Certification - Kalispell, Montana
1996: Inter-Fluve, Inc. “Design of Natural Stream Channels” - Bozeman, MT

**RECENT PUBLICATIONS (RELEVANT)**

Dalbey, S., J. DeShazer, L. Garrow, G. Hoffman, and T. Ostrowski. In press. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Presented to the Bonneville Power Administration, Portland, Oregon.

U.S. Bureau of Land Management. 1995. Colorado River cutthroat trout reintroduction plan decision record and environmental assessment WY-037-05-028. Prepared by U.S. Department of Interior, Bureau of Land Management, G.C. Hoffman. 84pp.

Hoffman, G.C.. 1994. Creel survey and tournament assessment of Lake Winnebago, Wisconsin: 1989 - 1992. Master's thesis. University of Wisconsin, Stevens Point. 1,815 pp.

**Larry F. Garrow**
**Fisheries Fieldworker III**

**Degree Earned**

University of Montana - Missoula, MT
B.S. in Wildlife Biology with an emphasis in aquatic and fisheries management, December 1985

**Current Employer**

Montana Department of Fish, Wildlife and Parks
475 Fish Hatchery Road
Libby, MT 59923
(406) 293-4161

**Current Responsibilities**

Act as crew leader on the BPA funded Libby Reservoir Project supervising and scheduling, under the direction of the project biologist, one to three fisheries technicians. Primary duties include assisting project personnel in fisheries research, monitoring and enhancement of fish populations within the Kootenai Basin. Ensure that equipment is properly maintained and organized. Enter, proof and summarize data into statistical and graphical formats for completion of project reports. Locate, document and prioritize potential mitigation sites and prepare site plans, obtain permits and work with landowners and contractors. Following public scoping, implement projects that will provide the greatest benefit to the fisheries.

**Recent Employment**

Fisheries Fieldworker III; Montana Department of Fish, Wildlife and Parks (MFWP); Libby, MT 02/92 to present

Interim Fisheries Biologist; MFWP; Libby, MT; 09/94 to 01/95

Fisheries Fieldworker II, I; MFWP; Libby, MT; 06/89 to 09/92

Fisheries Fieldworker I; MFWP; Superior, MT; 04/89 to 06/89

Fisheries Laborer I; MFWP; Fort Peck; MT; 04/88 to 07/88

Experimental Biology Aide I; Oregon Department of Fish and Wildlife; Charleston, OR; 10/87 to 01/88

Stream Surveyor; Oregon Department of Fish and Wildlife; Powers, OR; 07/87 to 09/87

**Expertise**

Field sampling and data collection using backpack, mobile and boom electrofishing methods, gill nets, hoop traps, fyke nets, Idaho weir traps, beam trawls, Schindler traps, Wisconsin nets, setlines, and draft tube nets.

Scheduling and coordinating the logistics of field operations.

Collection and enumeration of reservoir and lake zooplankton samples. Enter, proof and correct the resulting data.

Operation of outboard and I/O jet and prop boats safely and effectively.

Enter, proof and summarize data into statistical and graphical formats for completion of project reports.

**Recent Publications**

Dalbey, S., J. DeShazer, L. Garrow, and T. Ostrowski. In Press. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Methods and data summary, 1988-1996. Presented to the Bonneville Power Administration, Portland, Oregon.

Skaar, D., J. DeShazer, L. Garrow, T. Ostrowski and B. Thornburg. 1996. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Investigations of fish entrainment through Libby Dam, 1990-1994. Presented to the Bonneville Power Administration, Portland, Oregon. 80 pp, plus appendices.

**JAY A. DE SHAZER**
**FISHERIES TECHNICIAN**
Montana Fish, Wildlife and Parks
475 Fish Hatchery Road
Libby, MT 59923

## EDUCATION

Montana State University; Bozeman, MT
Bachelor of Science *in* Fish and Wildlife Management, June 1989

## CURRENT RESPONSIBILITIES

Research, monitor and document the effects on fisheries caused by the construction and operation of Libby Dam. Identify and implement mitigation projects to enhance fisheries within the Kootenai River Basin. Survey, design and coordinate the implementation of habitat enhancement projects.

## RECENT EMPLOYMENT

Biological Technician; USFS; Rexford Ranger District; Eureka, MT; 06/89 to 04/91

**EXPERTISE**

- Well-versed in fisheries theories, principles, and methods of research, management, and conservation.
- Scientific and technical literature preparation and use.
- Fisheries and other environmental sampling methods and data analysis.
- Surveying, mapping and designing stream habitat enhancement.
- Personal computers and application programs, computer habitat simulation models, and GPS/GIS applications.
- Boat maintenance and operation
- Heavy equipment operation

1996: AFS Public Outreach Symposium - Bozeman, Montana
1996: Inter-Fluve, Inc. “Design of Natural Stream Channels” - Bozeman, MT
1995: Physical Habitat Simulation system - Logan, UT
1992: SCUBA Certification - Kalispell, Montana

**RECENT PUBLICATIONS (RELEVANT)**

Dalbey, S., J. DeShazer, L. Garrow, G. Hoffman, and T. Ostrowski. In press. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Methods and data summary, 1988-1996. Presented to the Bonneville Power Administration, Portland, Oregon.

Skaar, D., J. DeShazer, L. Garrow, T. Ostrowski, B.Thornburg. 1996. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Investigations of fish entrainment through Libby Dam, 1990-1994. Presented to the Bonneville Power Administration, Portland, Oregon. 80 pp, plus appendices.

## Section 10. Information/technology transfer

Project results will be published in BPA reports and, where applicable, peer reviewed journal articles. Monthly or quarterly reports to all agency and citizen groups. Electronically available via Kootenai Watershed web page (to be designed and available for access by spring 1998).